

US EPA Office of Research and Development

Ecological Cumulative Risk Assessment

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Assessment

Ecorisk is Cumrisk

- Ecologists pay attention to env. context
 - More aware of cumulative effects
- More interactions with toxicant
 - Food, shelter, etc.
- Must integrate across species
- Large effects so more epidemiology
 - Leads to observing cumulative effects
- Broad EPA mandates
 - Maintain and restore designated uses

Two Assessment Situations

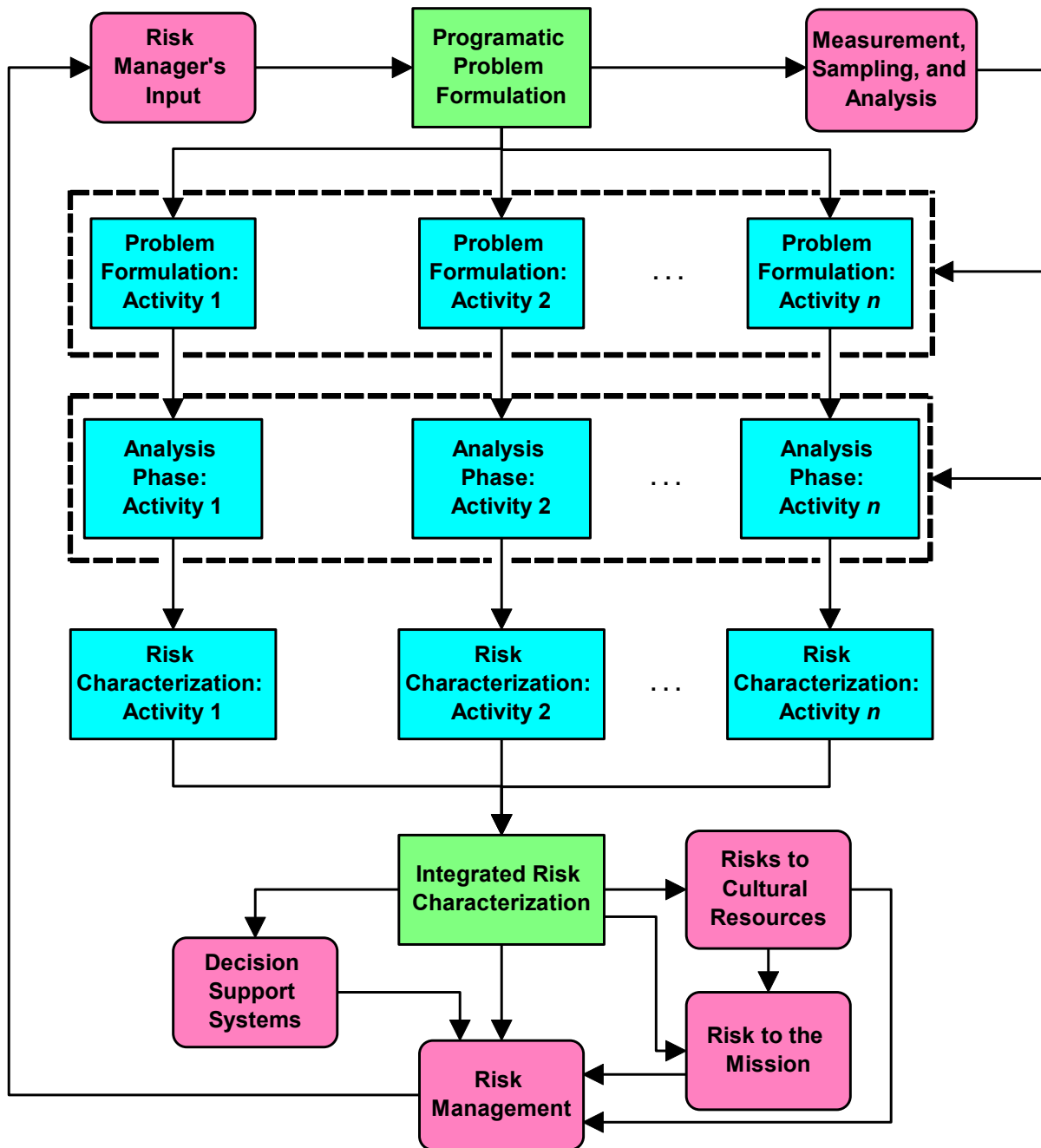
- Proposed New Action
 - Site specific – NPDES new permit
 - Generic – New chemical
- Contaminated or otherwise impaired
 - Superfund
 - TMDLs
 - NPDES repermitting
 - Existing pesticides

Site-Specific & Novel

- Toxic Risks, New Smokes and Obscurants
- Military Training and Testing
- Concern for Endangered Species
 - Red cockaded woodpecker in SE pine forests
 - Desert tortoise in Mojave
- Analogous to new source under NPDES

Military Desert Field Training





Each Activity has a Framework

Risk Analysis, Vol. 21, No. 2, 2001

Ecological Risk Assessment Framework for Low-Altitude Aircraft Overflights: II. Estimating Effects on Wildlife

Rebecca A. Efroymson^{1*} and Glenn W. Suter II²

An ecological risk assessment framework for aircraft overflights has been developed, with special emphasis on military applications. This article presents the analysis of effects and risk characterization phases; the problem formulation and exposure analysis phases are presented in a companion article. The framework addresses the effects of sound, visual stressors, and collision on the abundance and production of wildlife populations. Profiles of effects, including thresholds, are highlighted for two groups of endpoint species: ungulates (hoofed mammals) and pinnipeds (seals, sea lions, walruses). Several factors complicate the analysis of effects for aircraft overflights. Studies of the effects of aircraft overflights previously have not been associated with a quantitative assessment framework; therefore no consistent relations between exposure and population-level response have been developed. Information on behavioral effects of overflights by military aircraft (or component stressors) on most wildlife species is sparse. Moreover, models that relate behavioral changes to abundance or reproduction, and those that relate behavioral or hearing effects thresholds from one population to another are generally not available. The aggregation of sound frequencies, durations, and the view of the aircraft into the single exposure metric of slant distance is not always the best predictor of effects, but effects associated with more specific exposure metrics (e.g., narrow sound spectra) may not be easily determined or added. The weight of evidence and uncertainty analyses of the risk characterization for overflights are also discussed in this article.

KEY WORDS: Ecological risk assessment; risk assessment; military; aircraft

1. INTRODUCTION

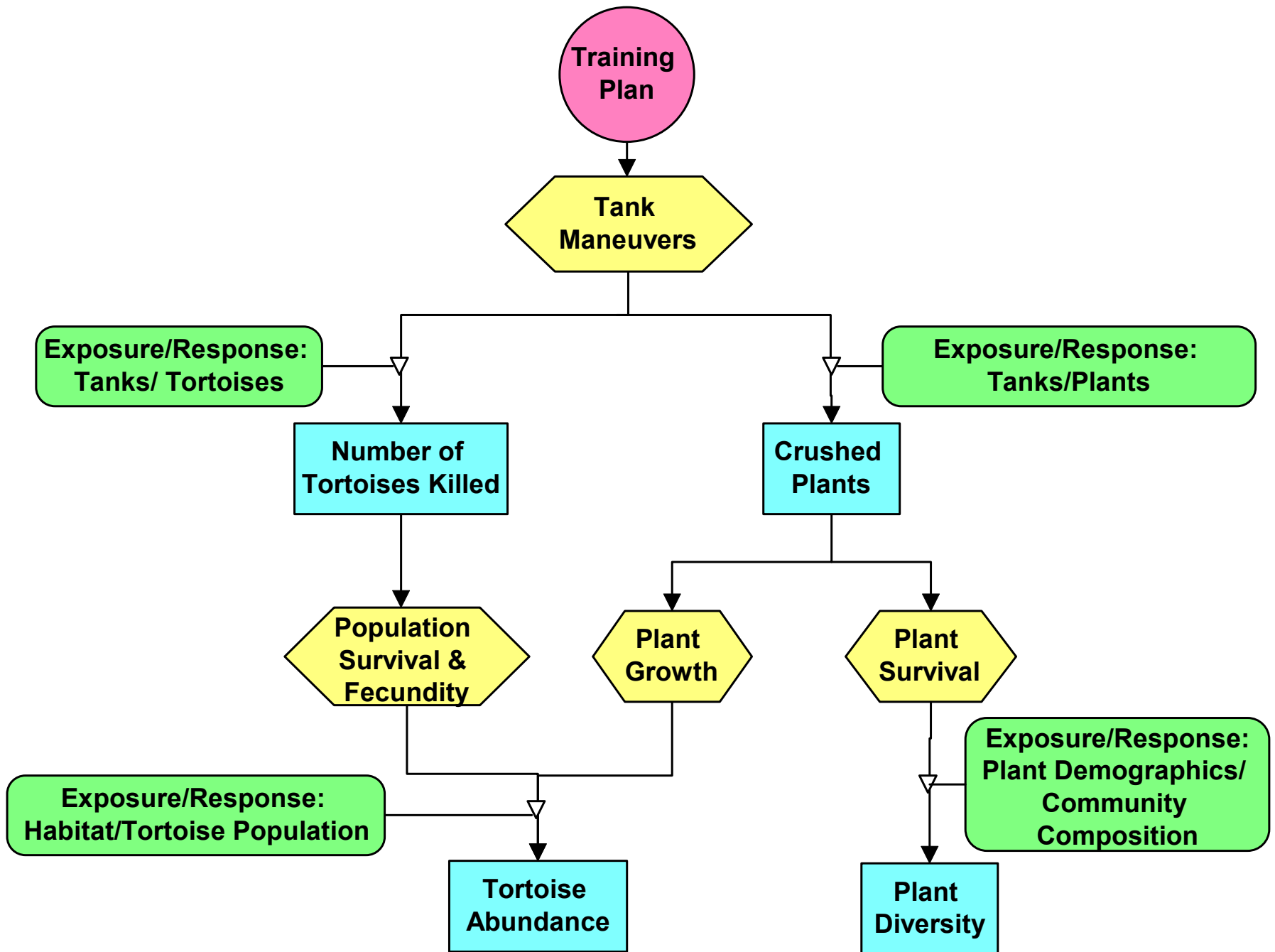
An ecological risk assessment framework for military training and testing activities is in development. The framework is intended to provide a logical and potentially standardized methodology for assessing risks

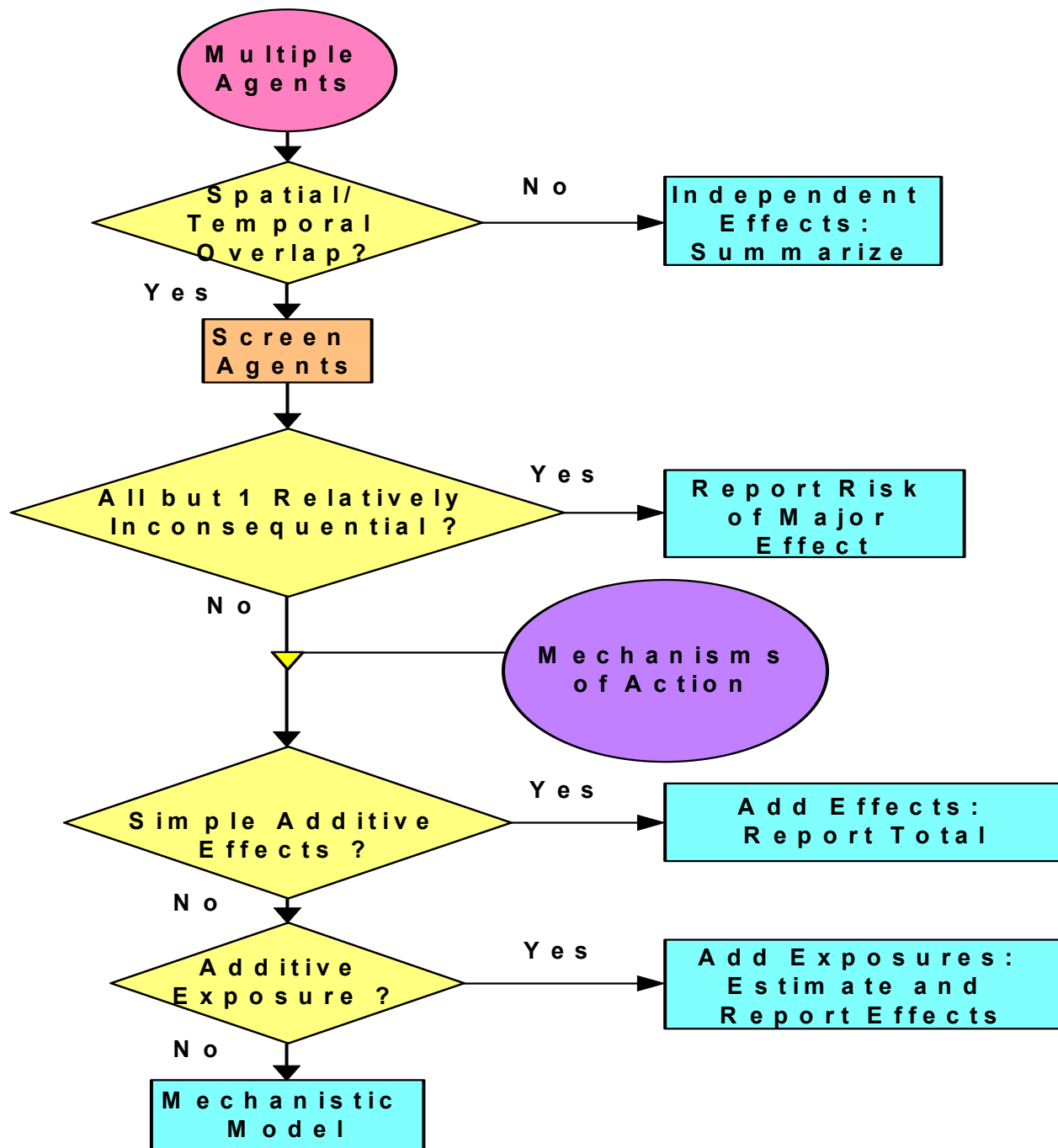
and to facilitate the quantification of effects and uncertainties. Potential applications of the framework include environmental impact statements, biological assessments for the Endangered Species Act, and natural resource planning. This article presents the analysis of effects and risk characterization components for an ecological risk assessment framework for low-altitude, military-aircraft overflights, a priority training activity of the U.S. military. The problem formulation and exposure analysis components appear in a companion article,⁽¹⁾ and the overflight risk assessment framework is described in detail in a report.⁽²⁾ Overflight training activities are assumed to consist of take-offs, in-flight maneuvers, and landings, but not drop-

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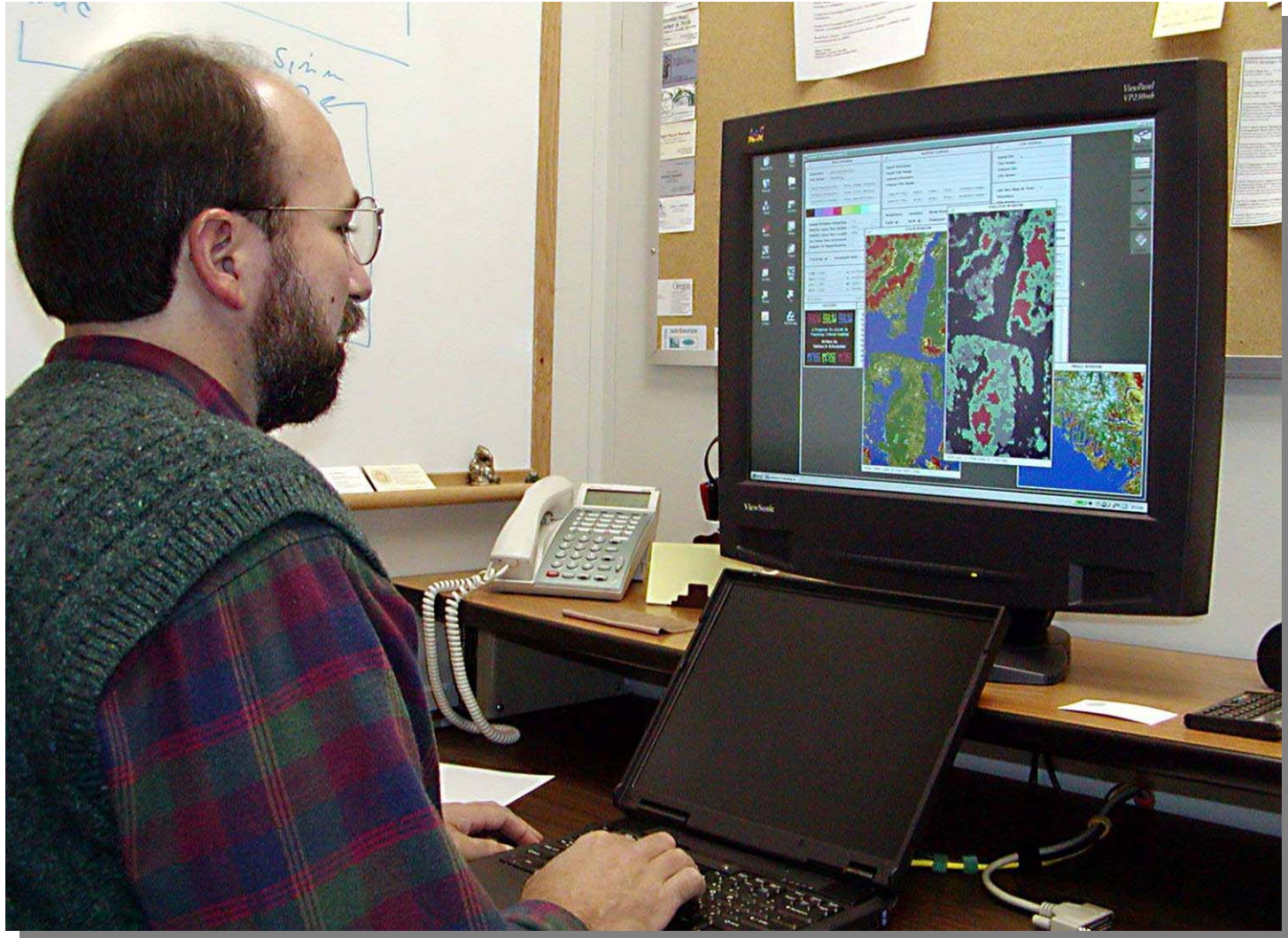
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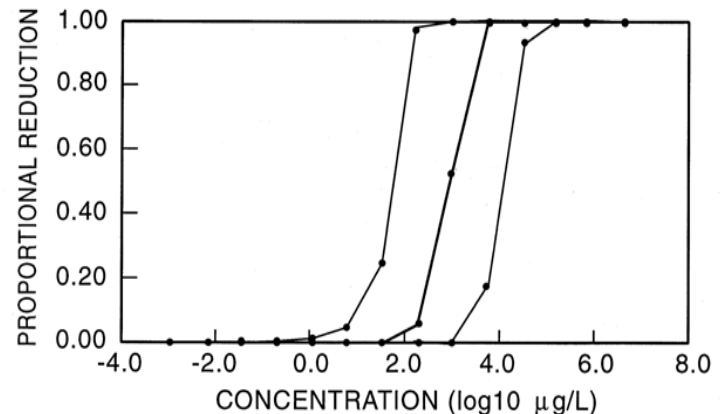


Modeling and Visualization



Integration of Heterogeneous Effects: the Common Units Problem

- Go to higher level
 - Toxicants and harvesting
 - Population abundance or production integrates
- Integrative Units
 - Emergy and Empower
- Economic Units
 - Market
 - Service replacement
 - Nonmarket
 - Survey-based
 - Contingent Valuation



An Alternative: Computational Toxicology

- Same strategy, lower level
- Heterogeneous effects at molecular level
- Integrate up to cumulative effects at the organism level
- Veith et al. pursuing with estrogen agonists and vitellogenin induction in male fish

Impaired Ecosystems: Ecoepidemiology & Risk Assessment

- Biosurvey
- Bioassessment
- Causal Analysis
- Identification of remedial/regulatory alternatives
- Risk Assessment
- Decision and Action
- Monitoring of results

Why This Approach?

- We could see that conventional methods were not doing the job
 - Degraded systems where no standards violated
 - Undegraded systems where standards violated
 - Nationwide declines in biotic integrity
 - More aquatic T&E species
 - More waters listed as impaired
 - Overwhelming complexity

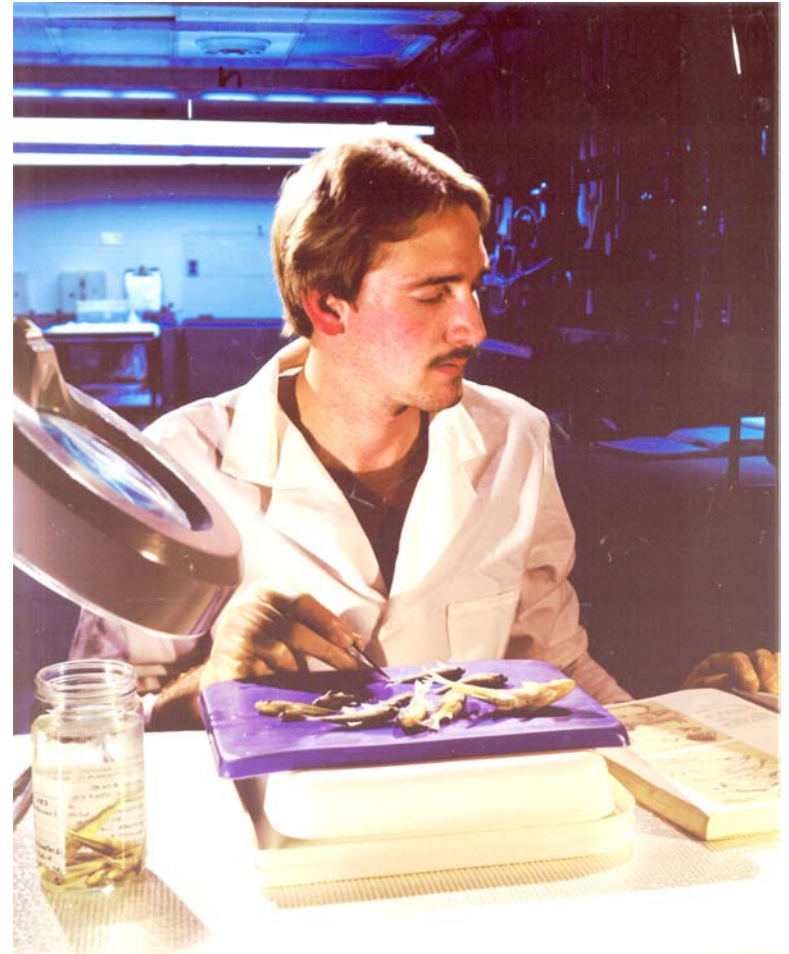
Fish Community Survey



Invertebrate Community Survey



Sample Processing



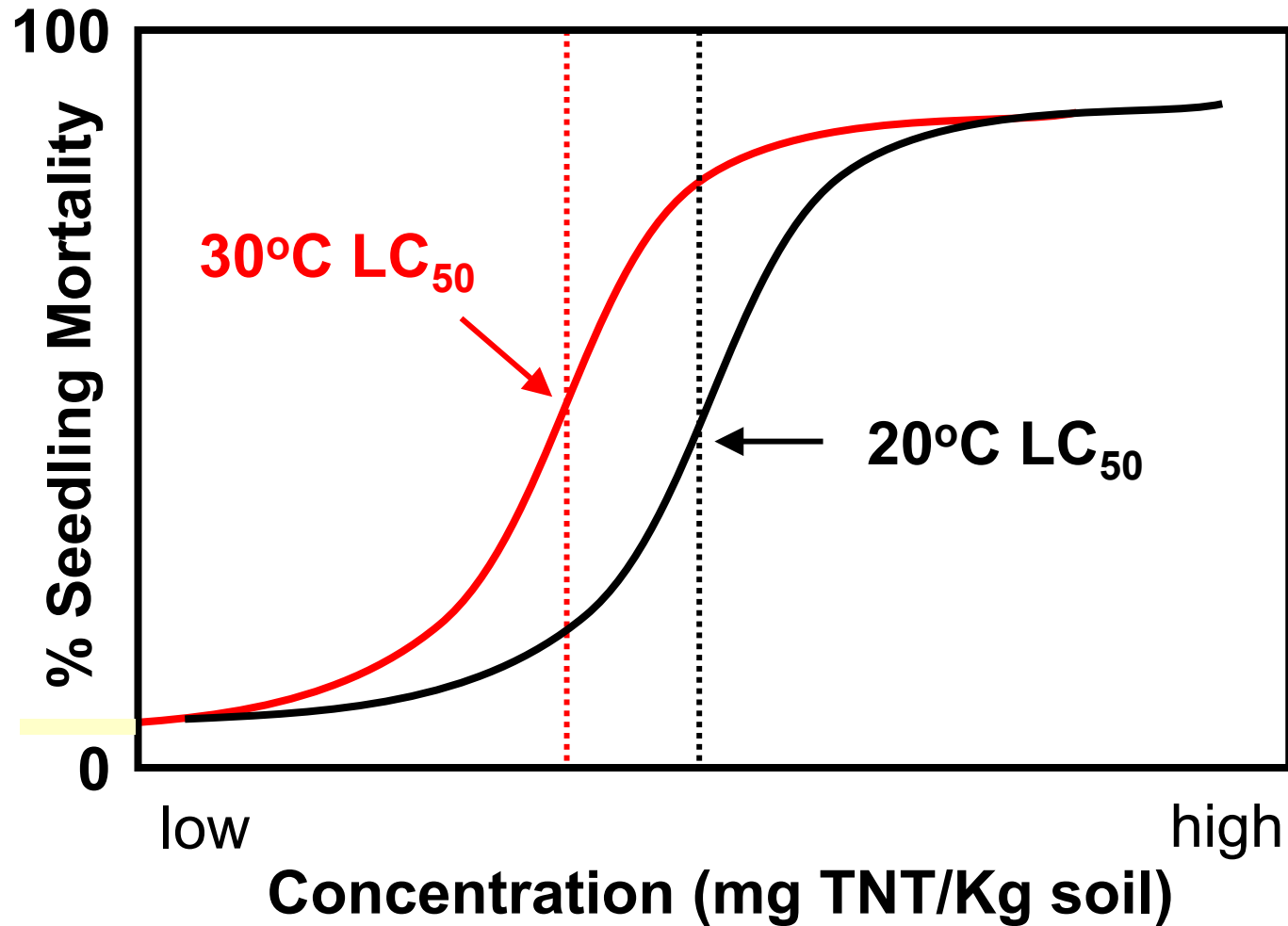
Media toxicity testing



Ceriodaphnia Ambient Water Toxicity Test



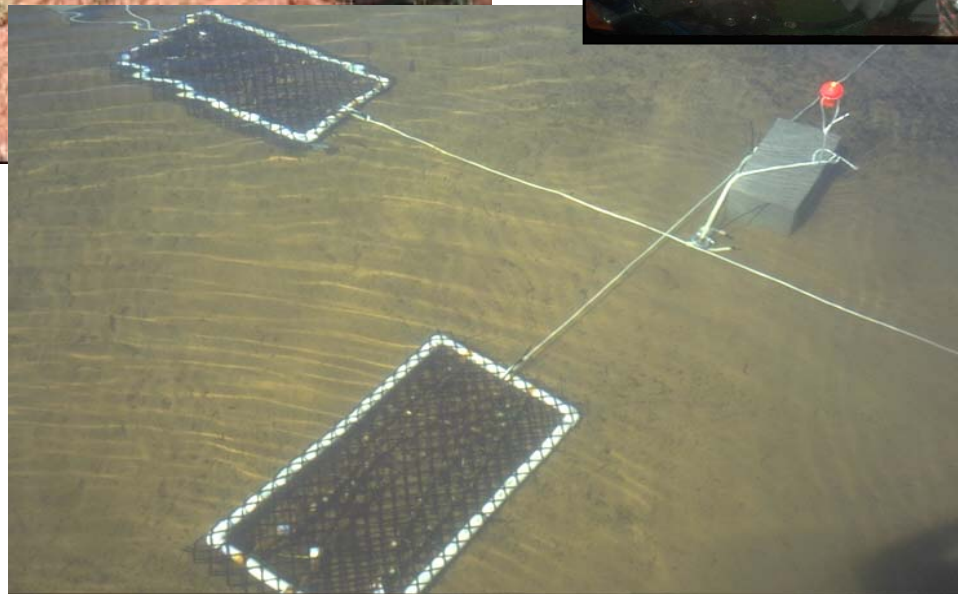
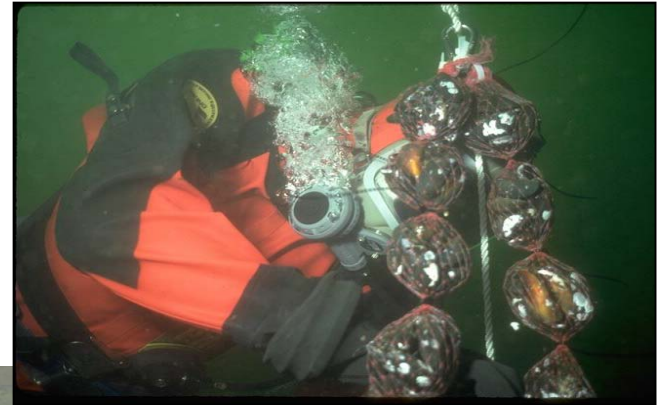
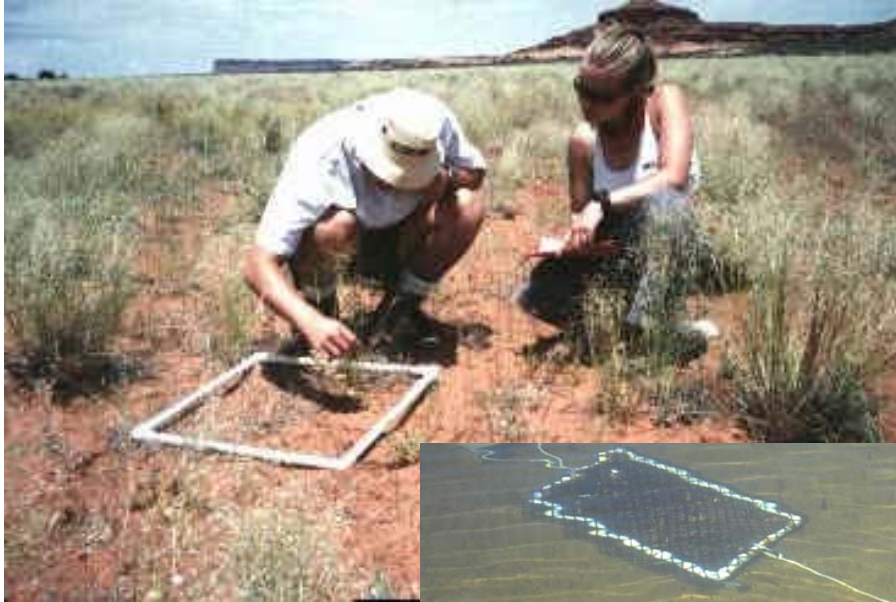
Dose-Response Curve



How Identify Toxic Component?

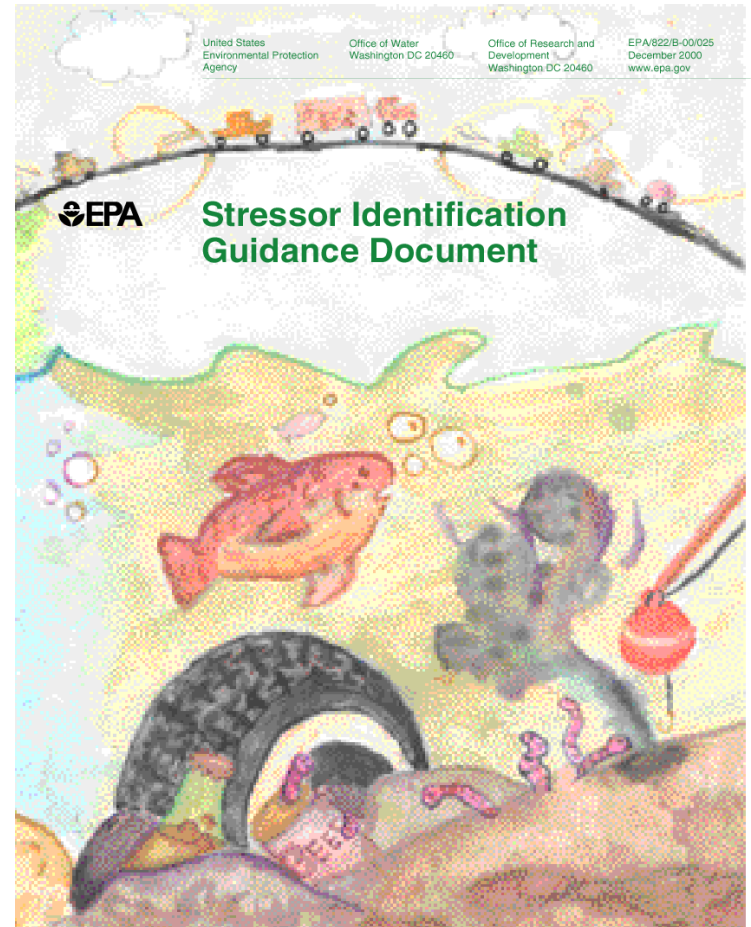
- Toxicity Identification/Evaluation (TIE)
 - Fractionate
 - Remove components
 - Retest

In Situ Testing



Ecoepidemiological Inference

- Cumulative effect?
 - Biosurvey and Bioassessment
- Is it due to toxicity?
 - In situ tests
 - Media tests
 - TIE
- What is the cause?
 - SIE



Methods to Characterize Causes



Eliminate

Most conclusive

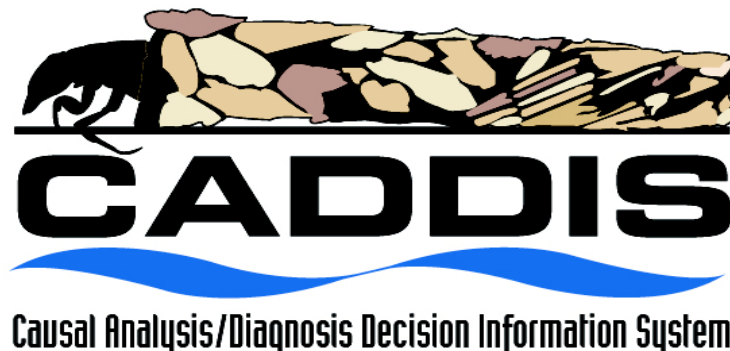
Diagnose

**Strength of
Evidence**

*Broadest array
of information*

Strength of Evidence

- Case-specific considerations
- Considerations based on other situations
- Considerations based on biological knowledge
- Consistency and Coherence



Summary of Differences

- Broader range of concerns
 - Indirect toxic effects
 - Nontoxic agents
 - But, can shift to integrative level of organization
- More reliance on epi. approaches
 - Lots of real and large effects
 - Can't avoid noticing failures
 - Ability to manipulate subjects
 - But, no medical records

Lessons for Health RA

- Use ecological sentinels
 - Integrating cum effects
 - More exposed and often more sensitive
- Use epi when you can
 - In weight-of-evidence context
- Test whole materials/media
- Use human ecology to really integrate
 - Human welfare is more than health